285 TechConnect Radio Club

Meeting for 10 September 2011

http://www.na➢tc.org/

Solve the Problem

- **How to make an RF sampler that:**
  - Can safely drive a spectrum analyzer (ie, Ensemble II) at 100 – 1500 watts of RF power, and
  - Needs minimal adjustment as bands are changed

Do you even need a sampler?

- Ensemble II with ***nothing attached to the antenna port***

Transmitter OFF

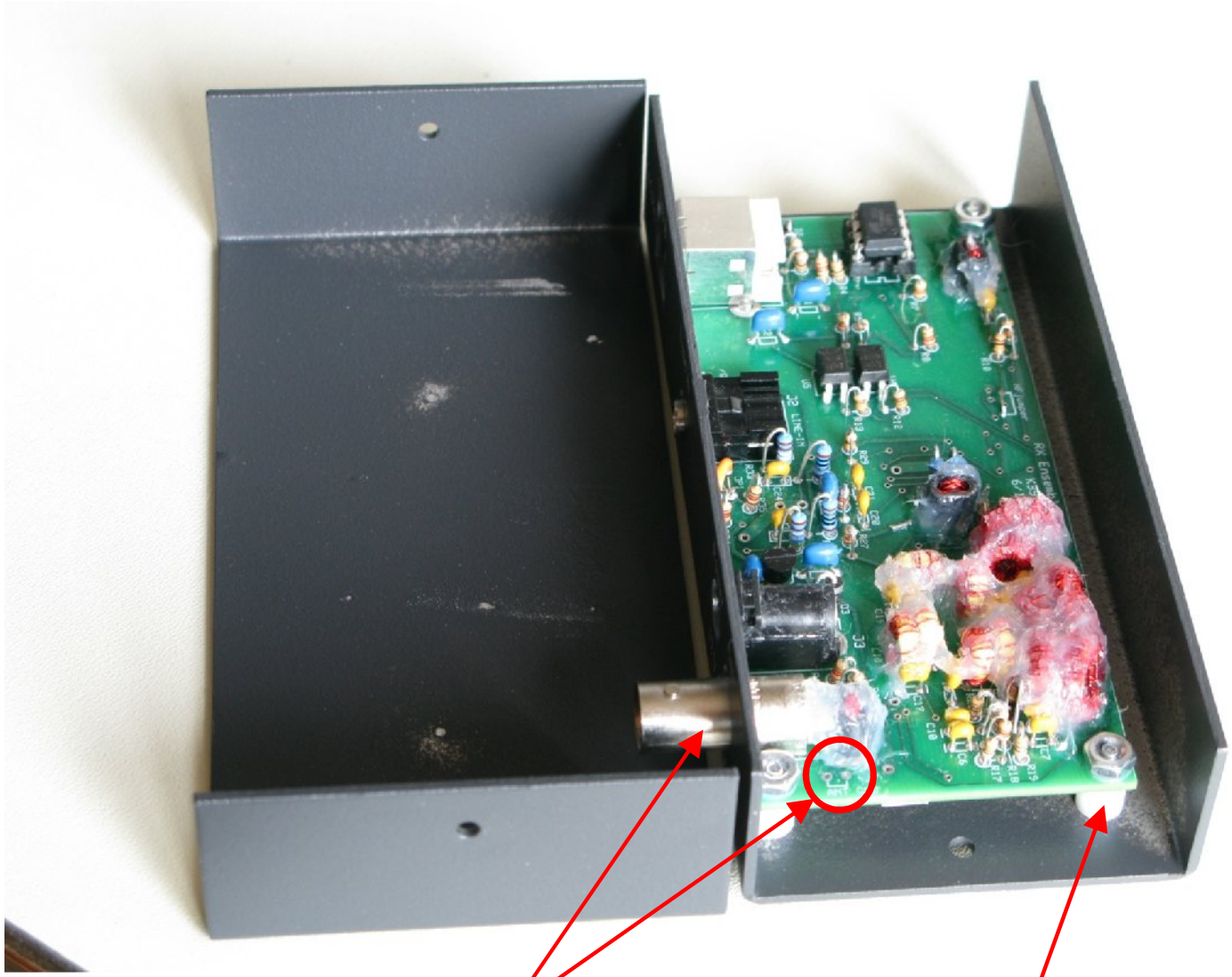
Transmitting on 14 MHz @ 1 watt into a dipole

S9 –

  - I am hoping to resolve this issue in the near future

Use *caution* while using the Ensemble II when transmitting

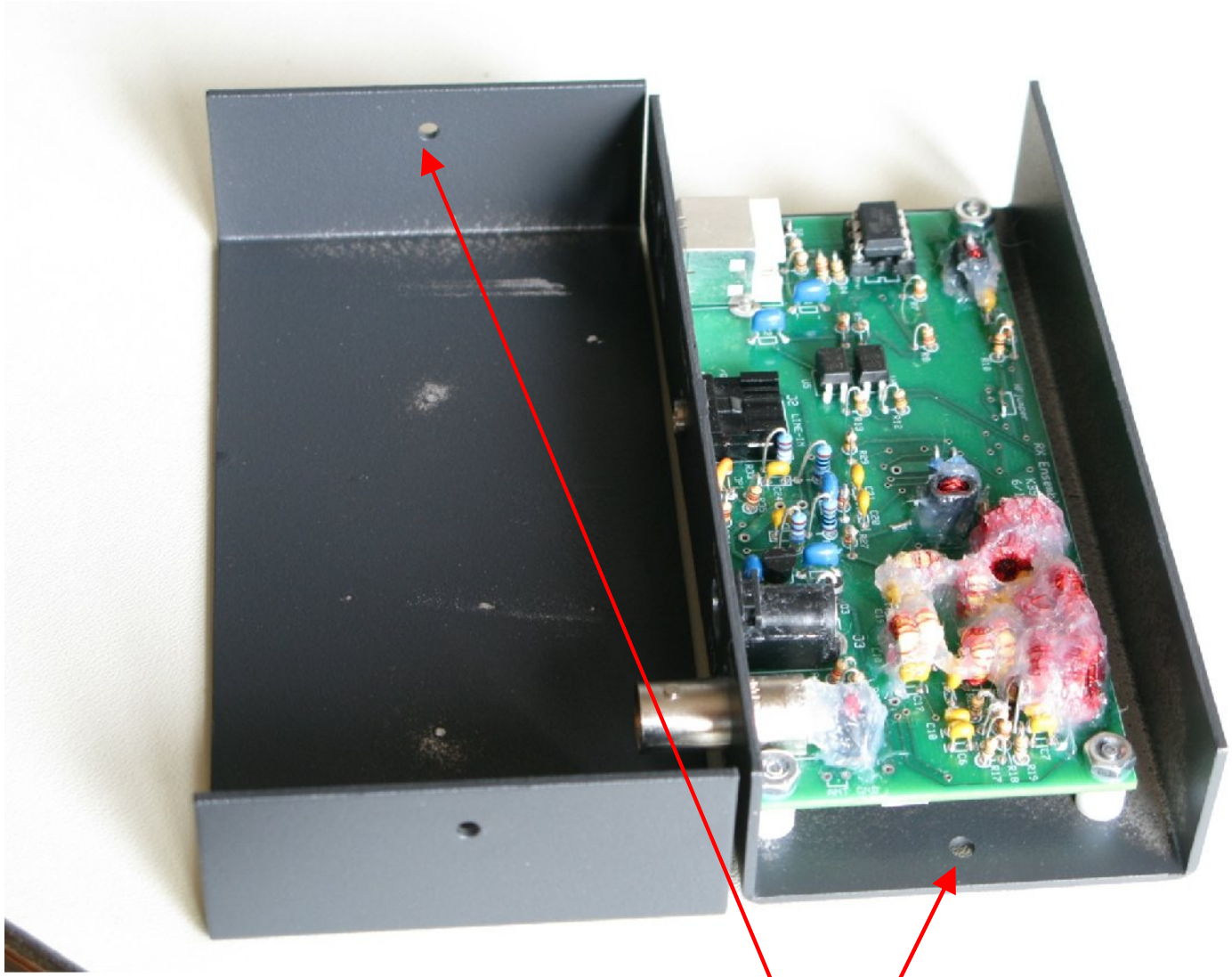
Ensemble II: Some simple RFI mods



RF input connector and RF ground
are isolated from RF ground

Box is isolated from board (4 places)

Ensemble II: Some simple RFI mods

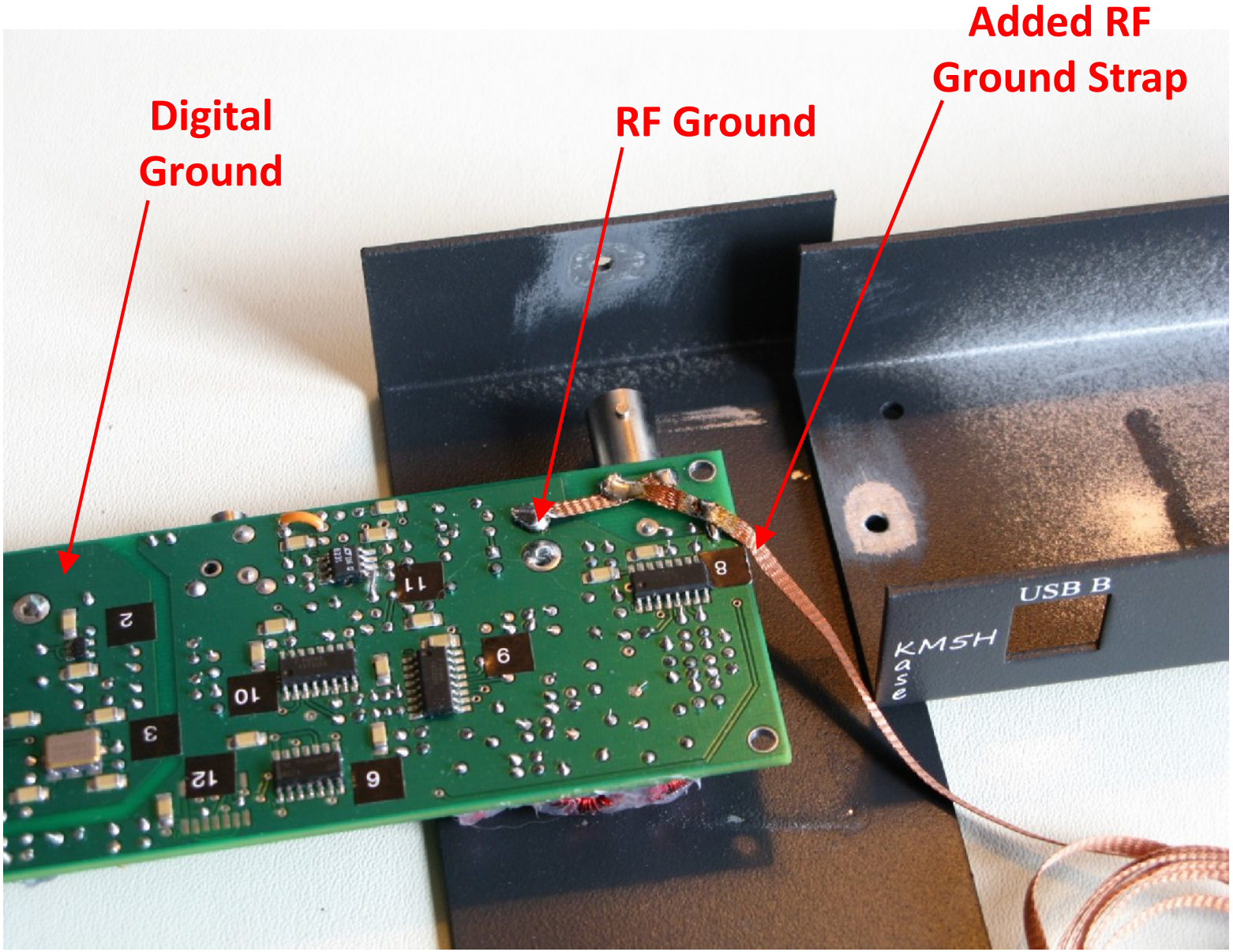


Isolated from box (4 places)

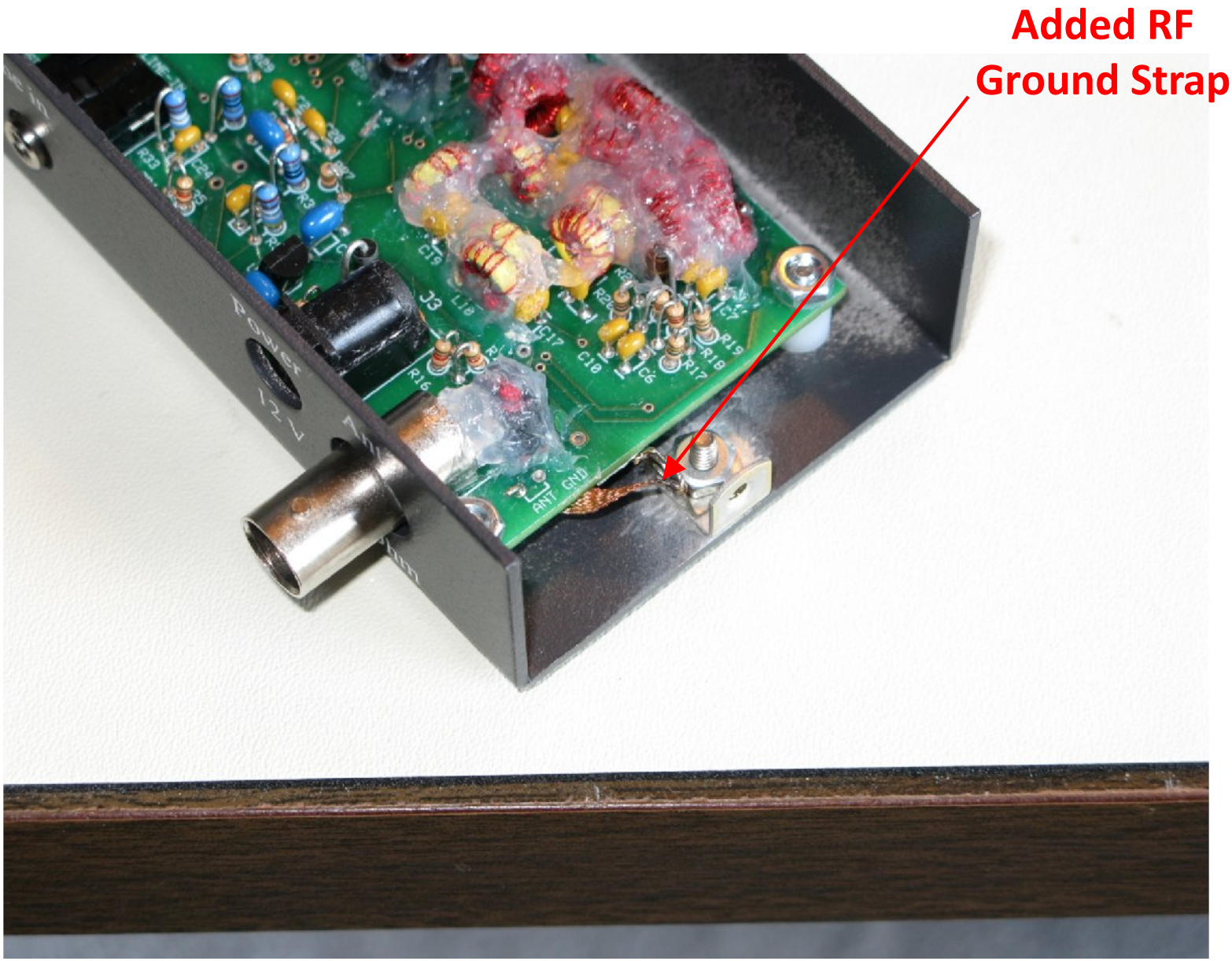
Ensemble II: Some simple RFI mods

Remove paint from box (4 places)

Ensemble II: Some simple RFI mods



Ensemble II: Some simple RFI mods



Ensemble II: Some simple RFI mods

Transmitting on 14 MHz @ 100 watts into a dipole

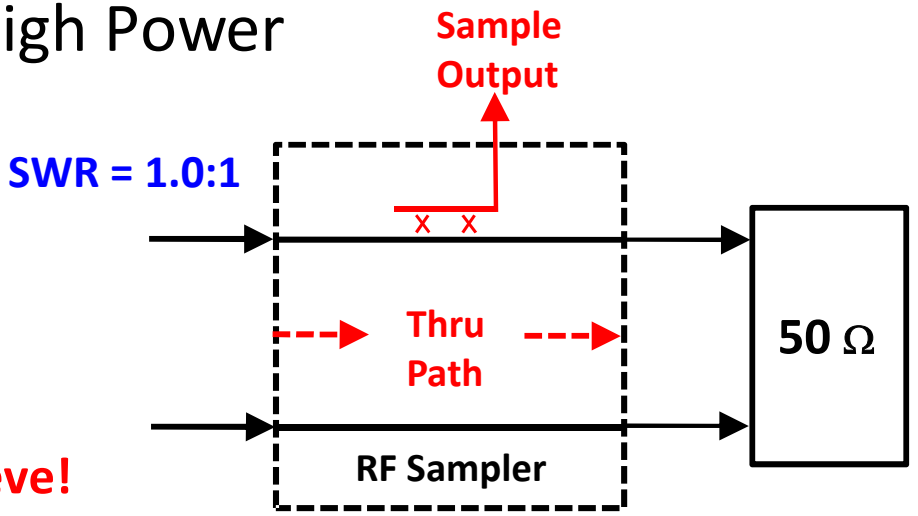
More to follow!

RF Sampler for High Power

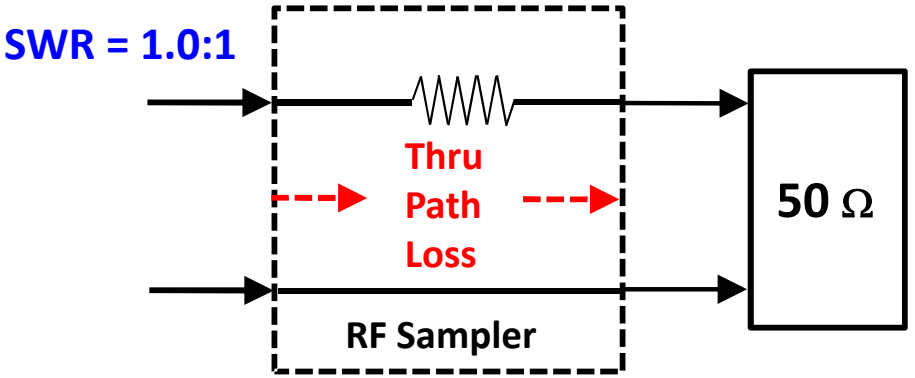
- **Design goals:**
  - Frequency range: 1-30 MHz
  - Maximum RF input power:
    - 100 w = +50 dBm
    - 1.5 Kw = **+62 dBm**
  - RF Sample output:
    - Maximum output level:
      - **Safety:**
        - » **0 dBm** (a good number for most sensitive instruments/receivers)
        - » Ensemble II: no spec, but 0 dBm should be a good number
          - Input device (FST3253) is spec'd at 0.5 Vp
      - **Distortion (Two-Tone IMD):**
        - » Ensemble II: no spec, but **S9 + 10 dB (-63 dBm) should be OK**
    - Flatness: best we can get, but not critical

RF Sampler for High Power

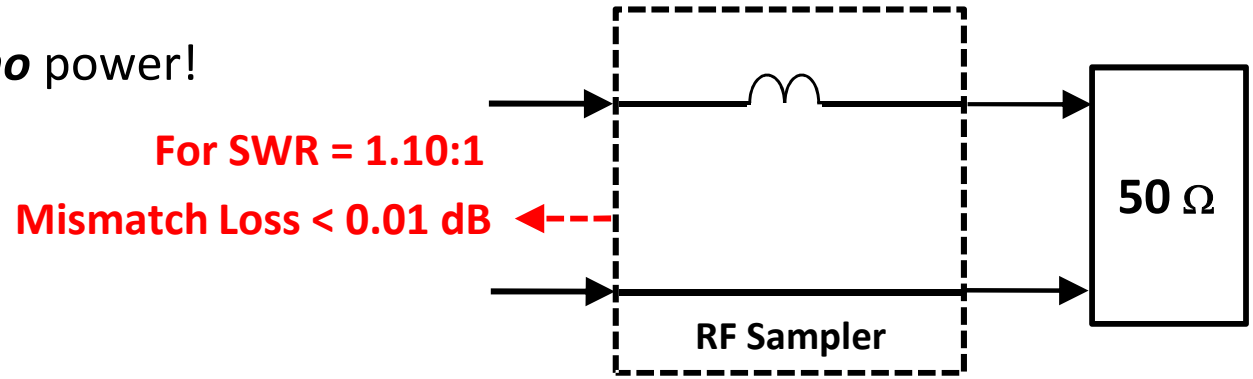
- **Design goals (continued):**
  - **Coupling factor**:
    - 100 w = +50 – (-63) = **113 dB**
    - 1.5 Kw = +62 – (-63) = **125 dB**
    - **Isolation > 90 dB can be hard to achieve!**
    - **Most SWR/power meters only need 20-30 dB**



  - **Insertion loss**:
    - Thru path loss:
      - needs to be ~0 dB
      - 0.1 dB at 1.5 Kw = 35 watts

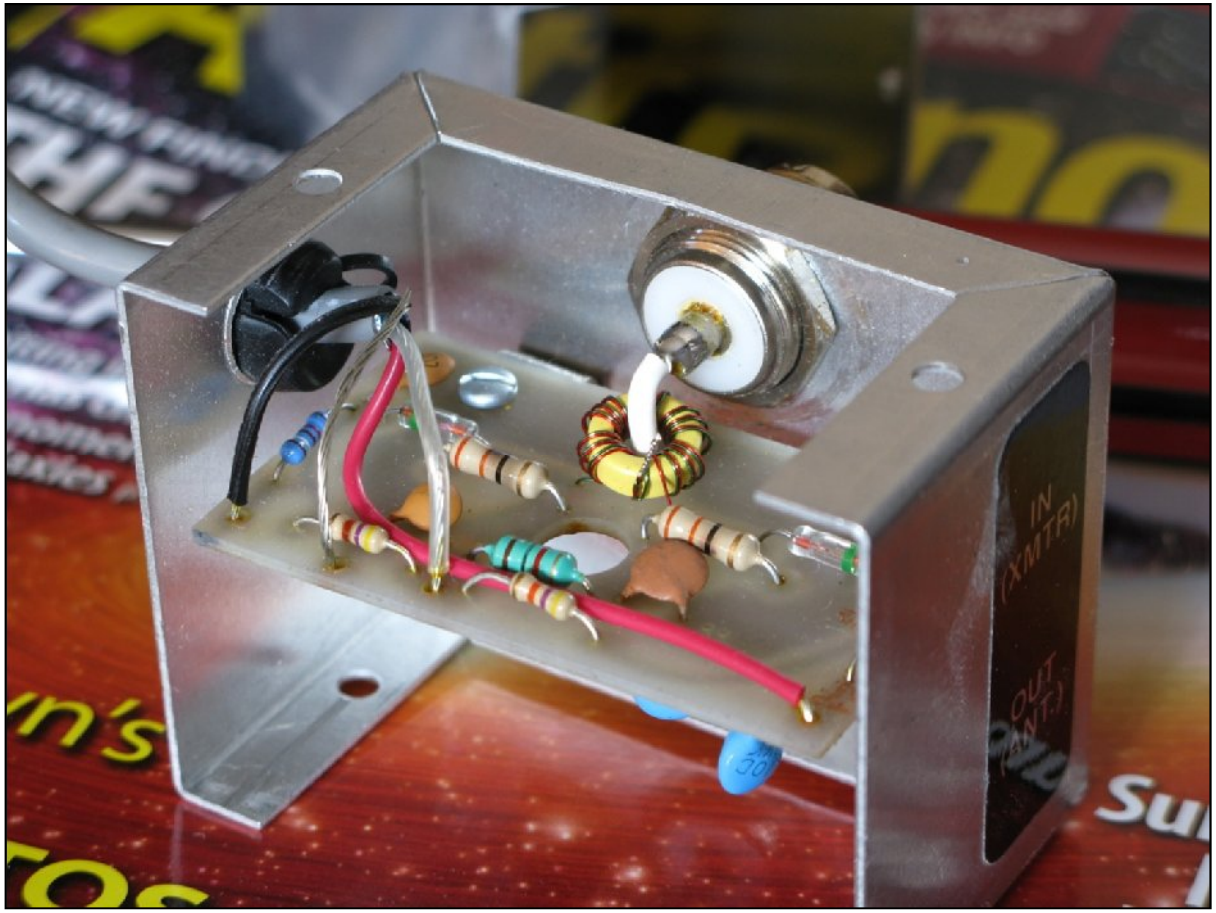


  - **Mismatch loss**:
    - Reactance dissipates ***no*** power!



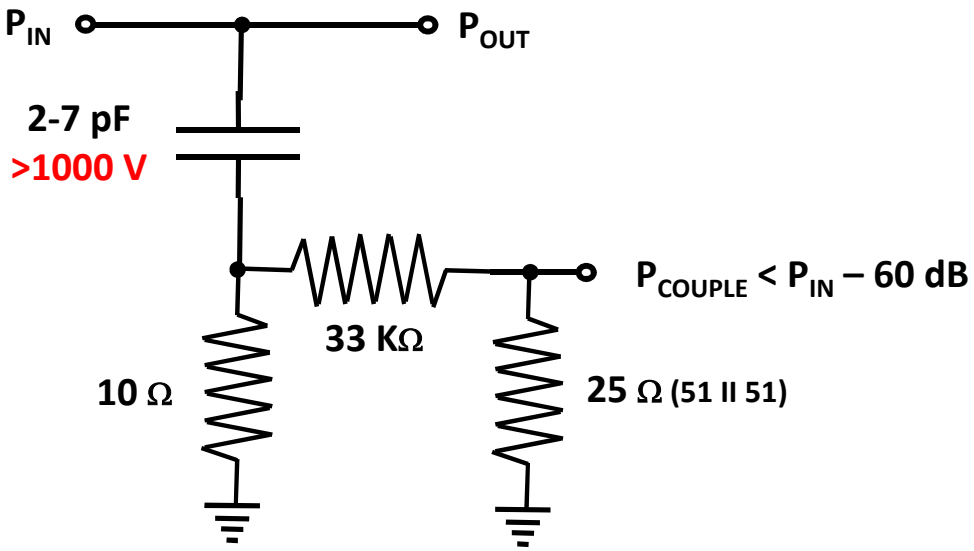
Which Circuit to Use?

- **Current probe:**
  - Commonly used in SWR and power meters
  - Issues:
    - Hard to get below (more negative than) -40 dB coupling factor
    - Core must be chosen carefully (1-30 MHz ***AND*** maximum power)



Which Circuit to Use?

- **Resistor/Capacitor network:**



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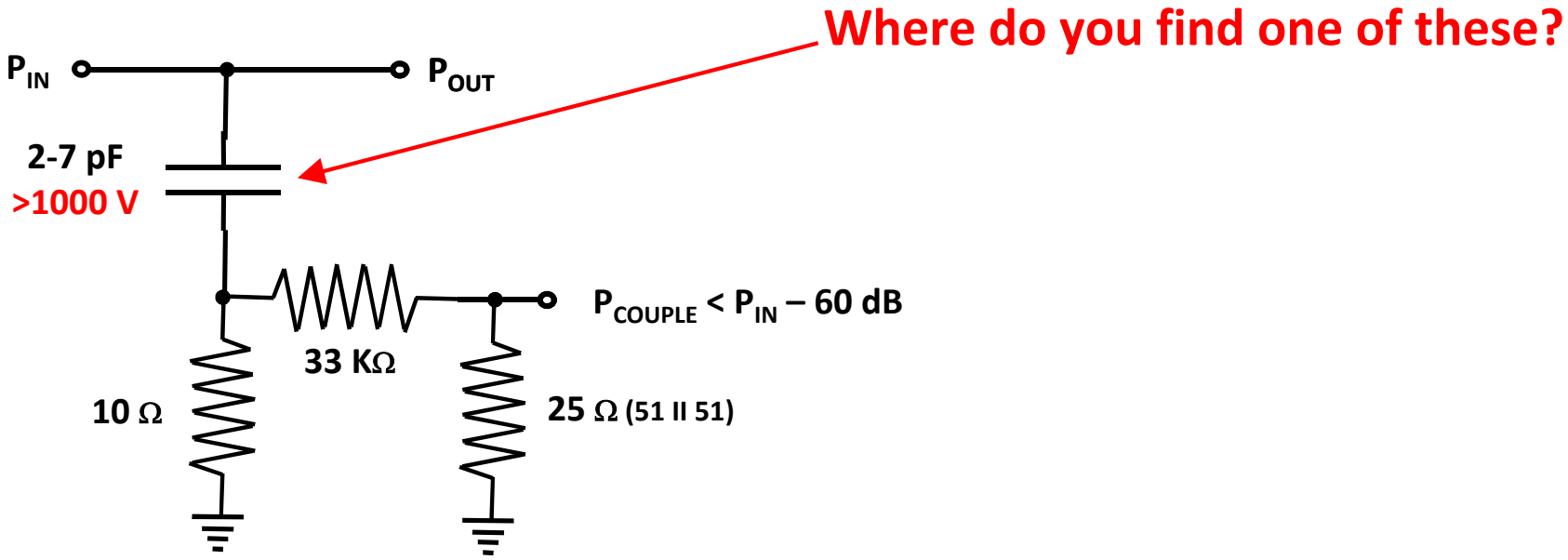

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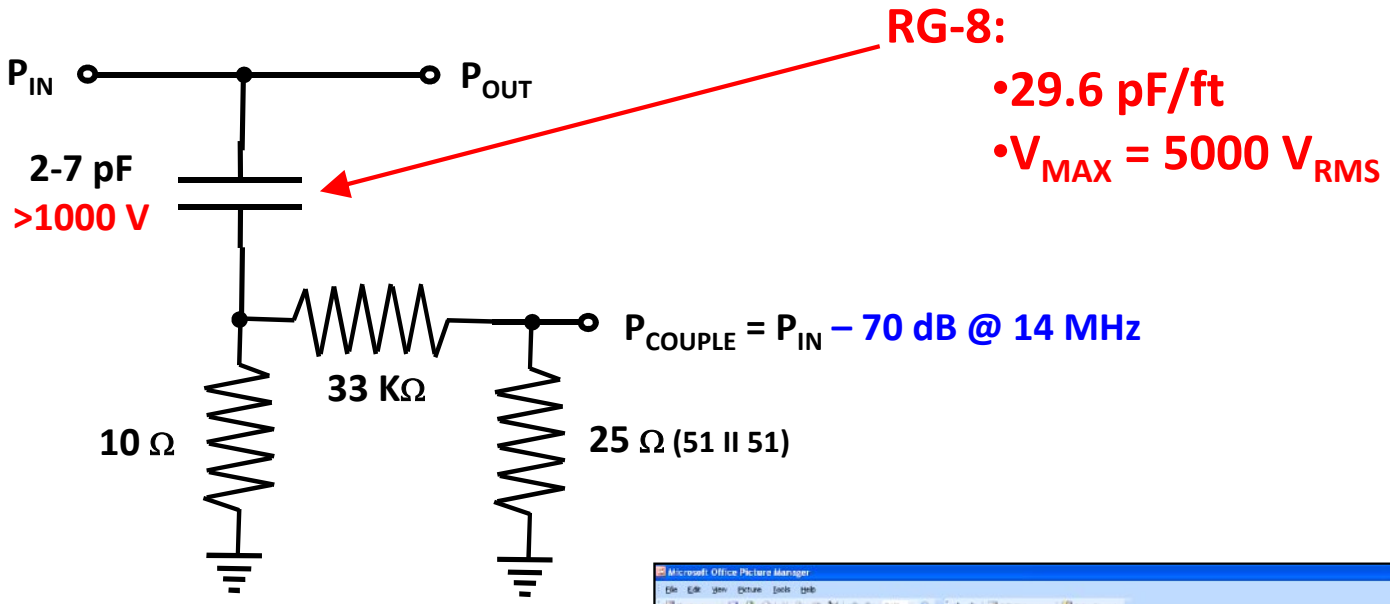

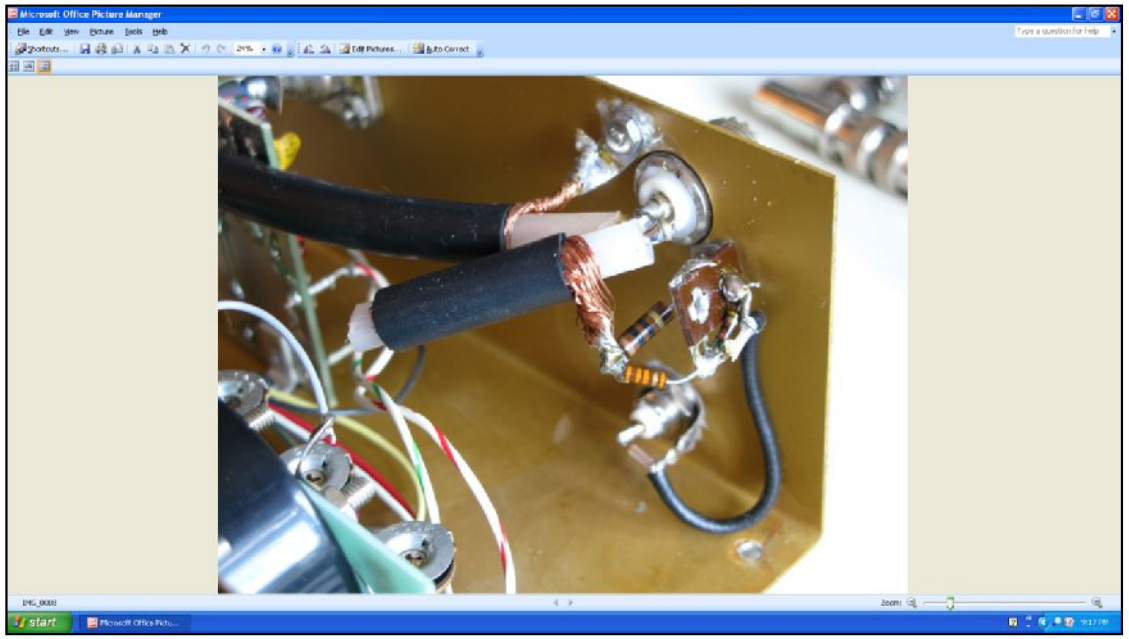

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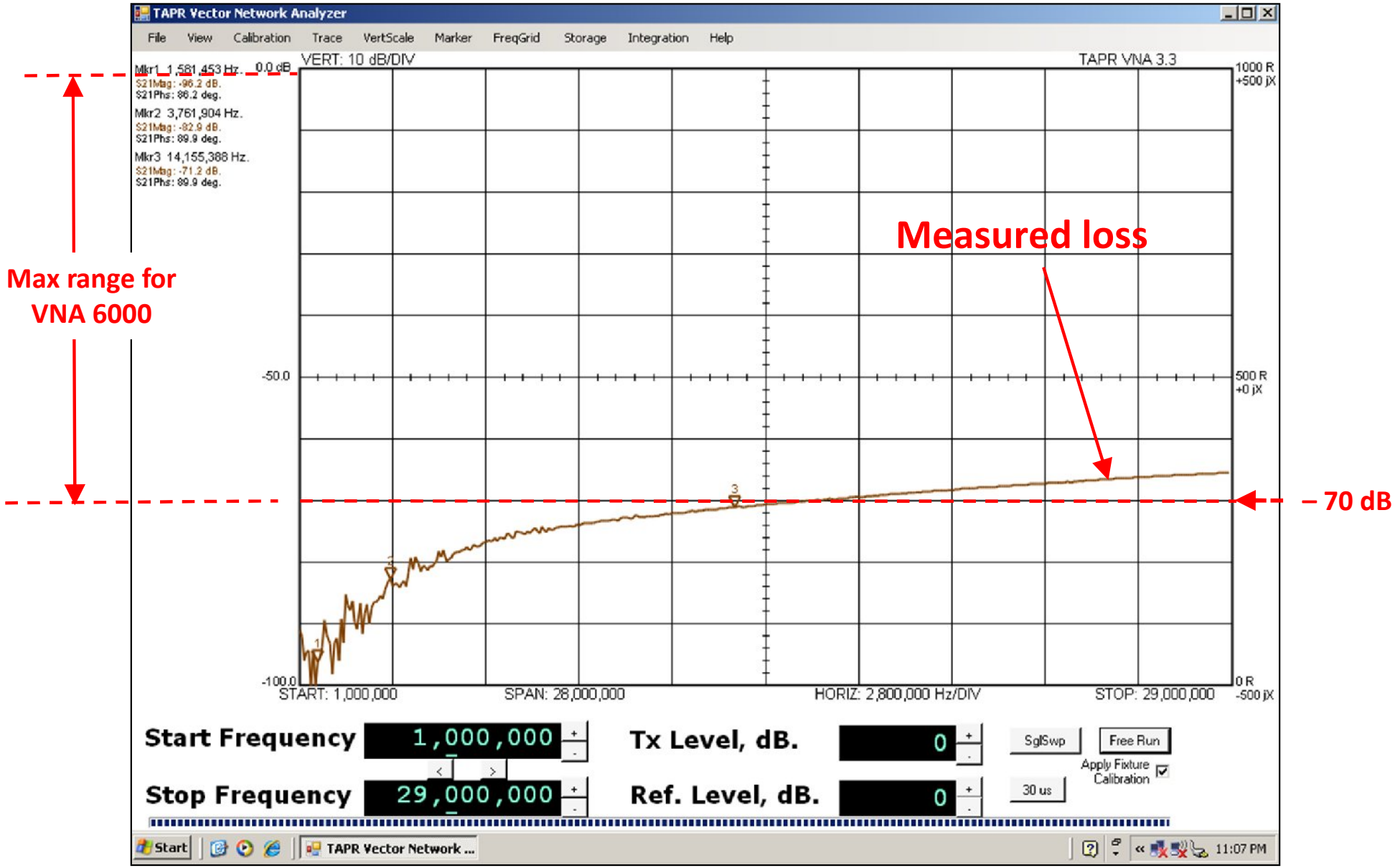
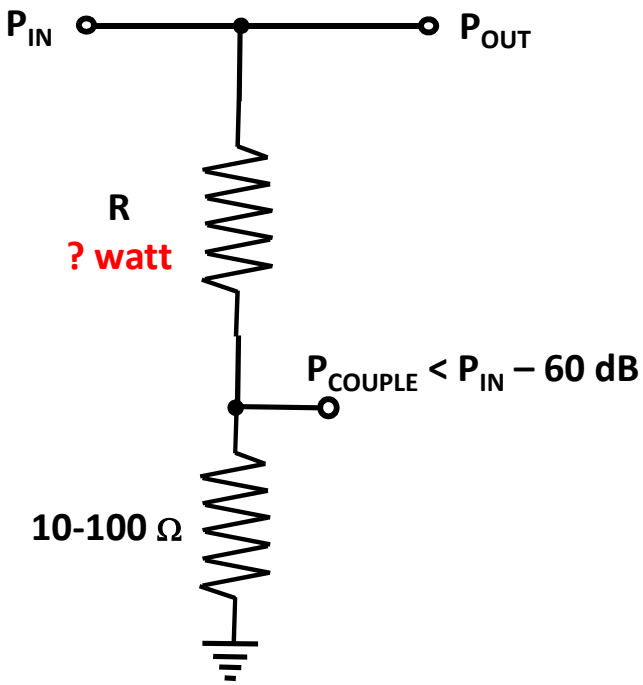
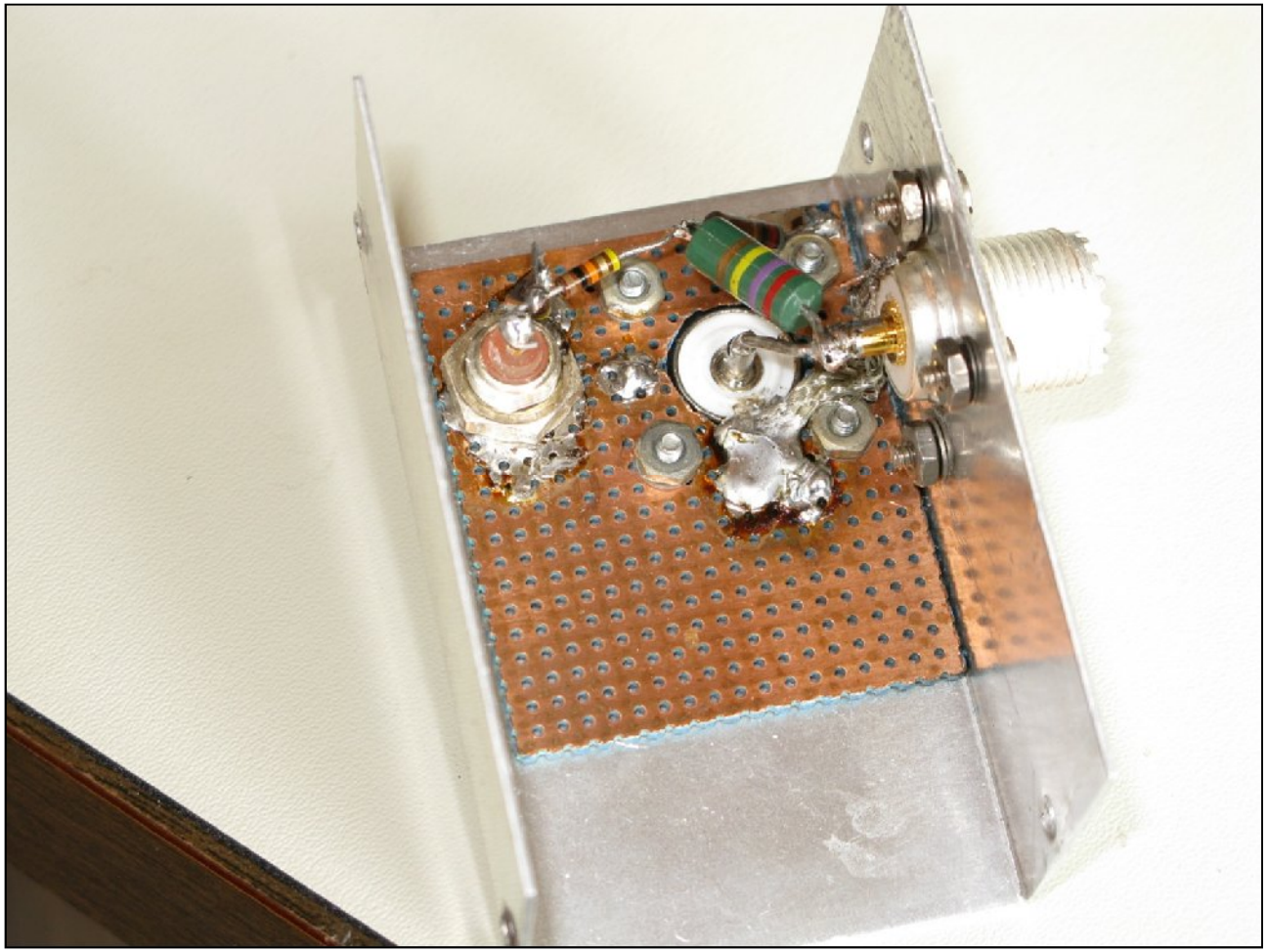


Which Circuit to Use?

- **Resistive divider network:**
  - Issues:
    - Wattage for resistor R
    - Other?





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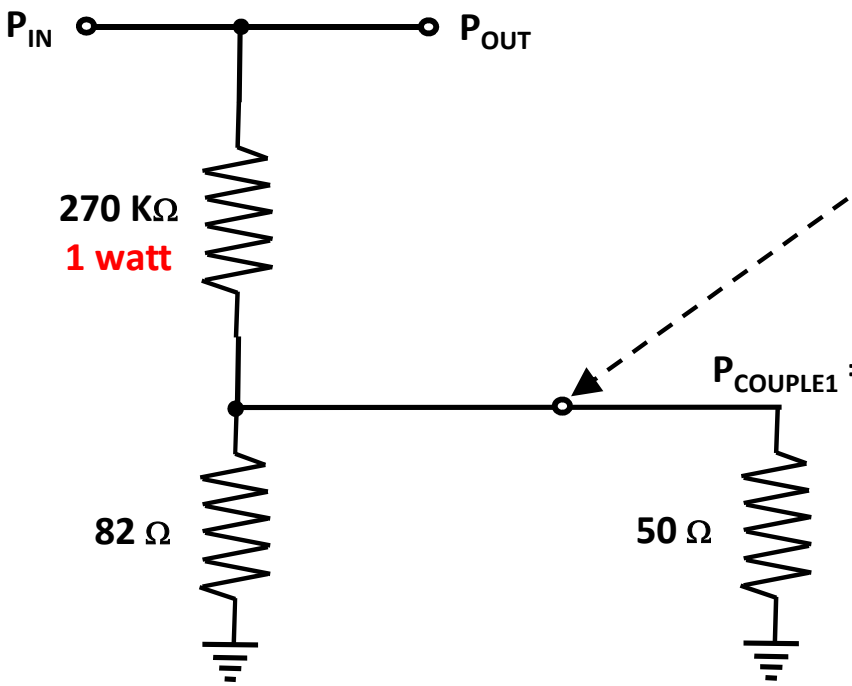
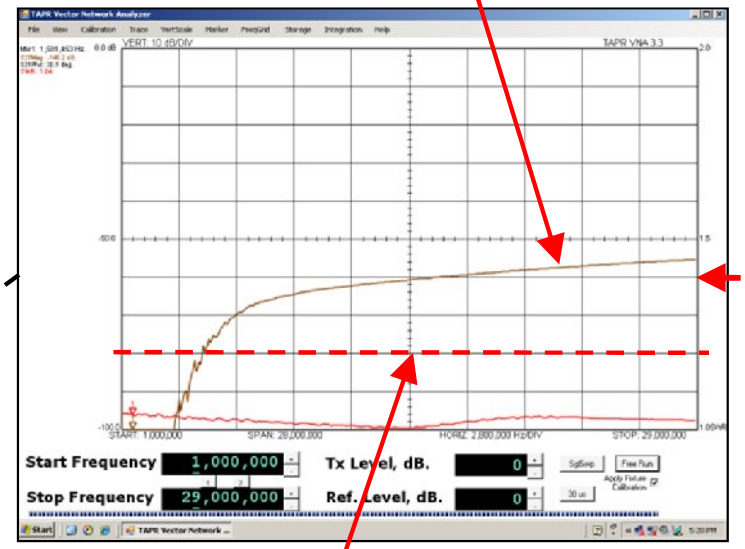


Measured loss

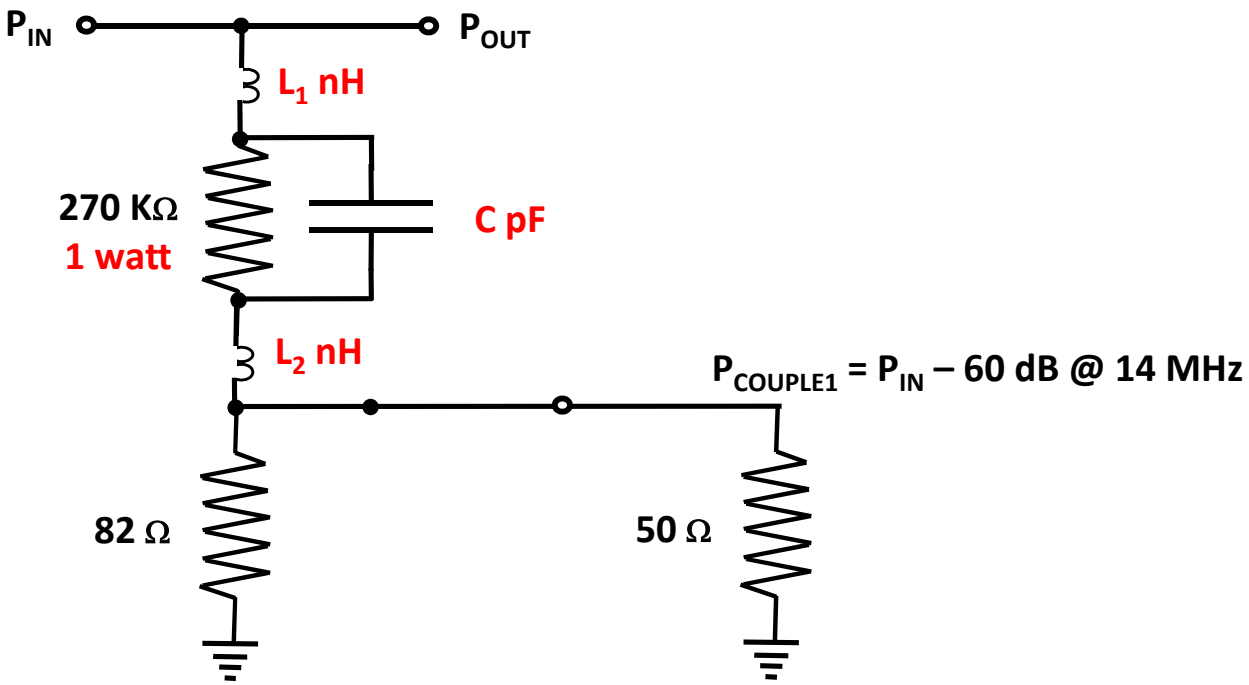


– 60 dB

Insertion loss should be -80 dB and flat??

Which Circuit to Use?

- **Resistive divider network:**
  - Issues:
    - Wattage for resistor R
    - Resistors at RF = ***RLC network***



Which Circuit to Use?

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  - Issues:
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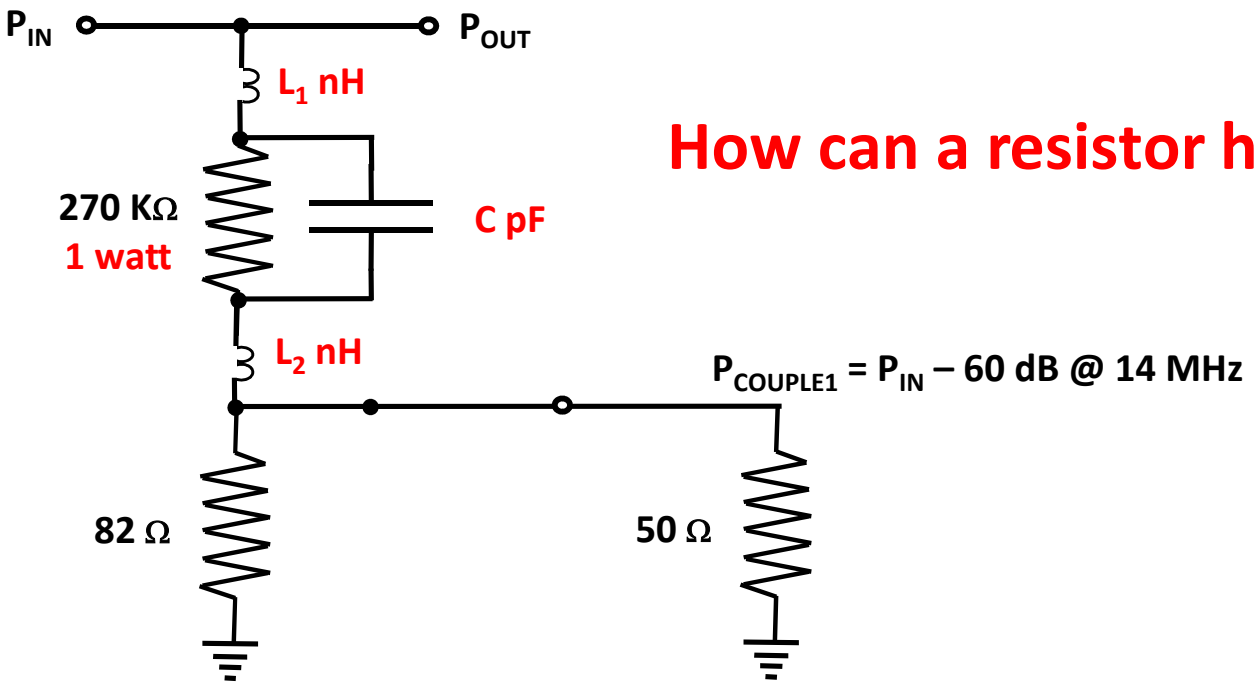
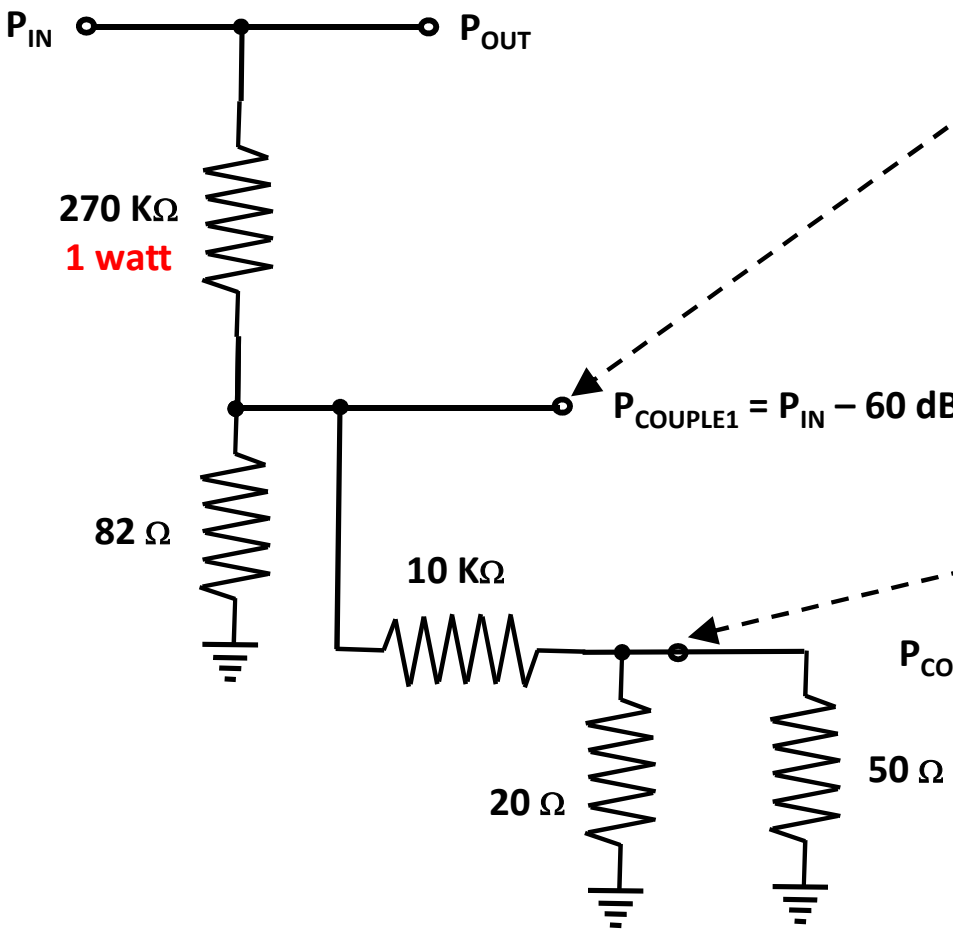
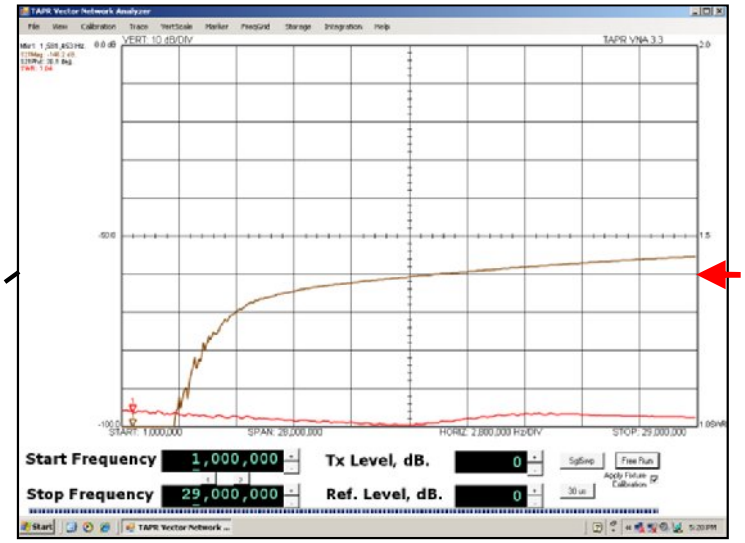


How can a resistor have capacitance?

Which Circuit to Use?

- **Resistive divider network:**
  - Issues:
    - Wattage for resistor R
    - Resistors at RF = RLC network

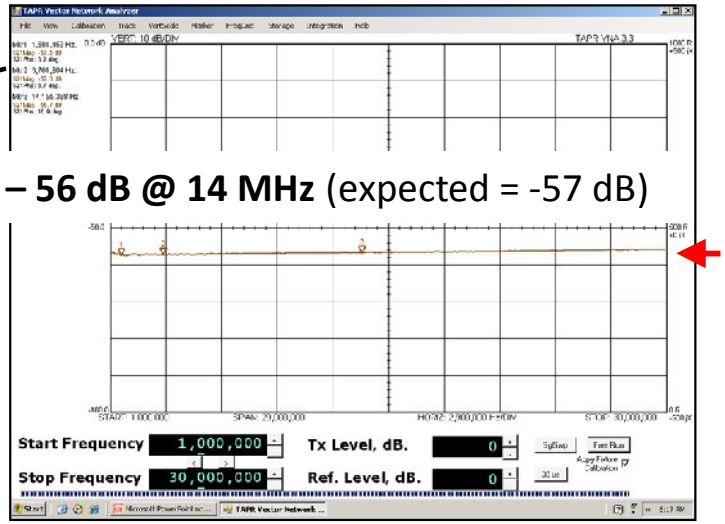




– 60 dB

$P_{COUPLE1} = P_{IN}$ – 60 dB @ 14 MHz

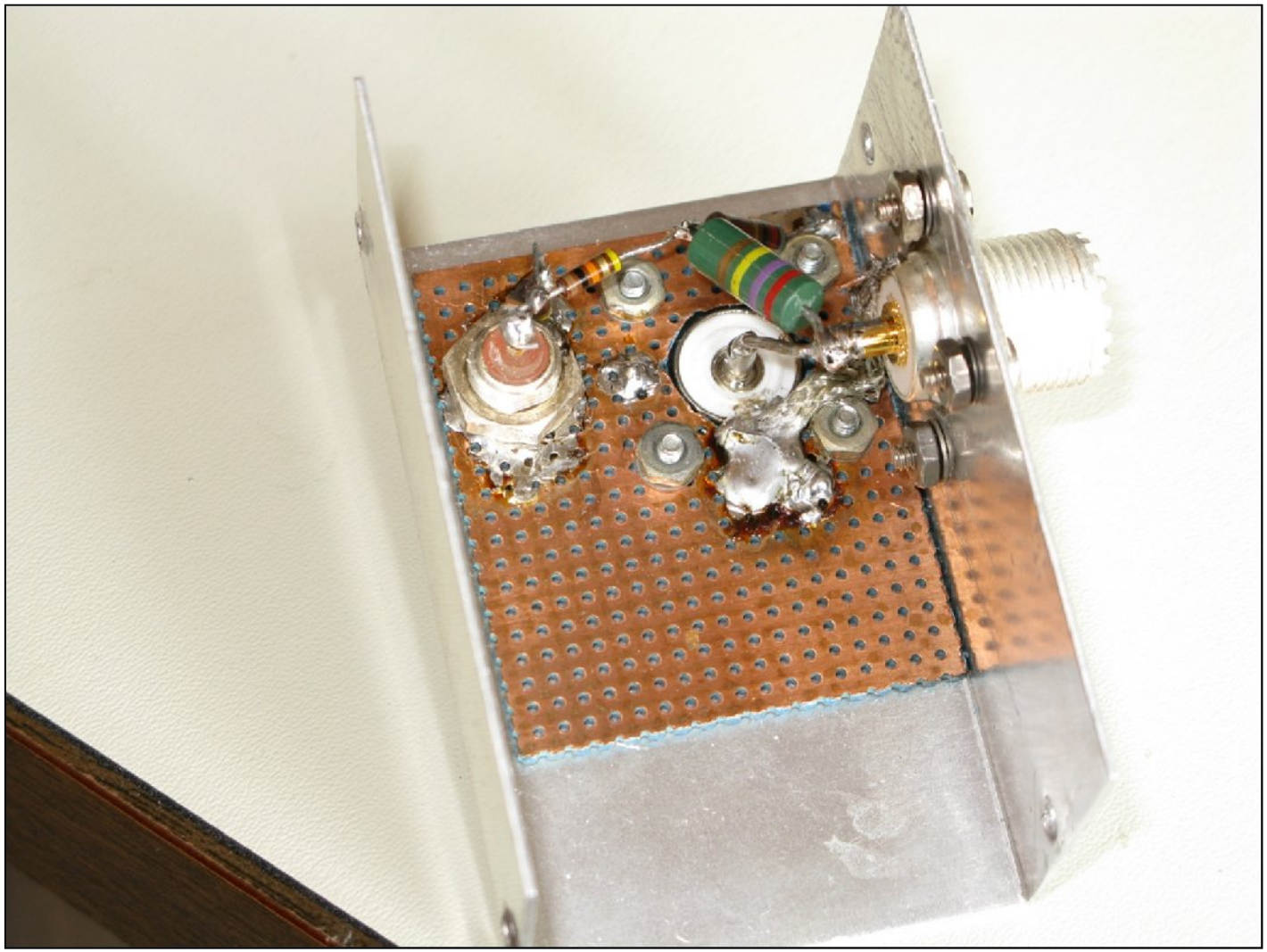
$P_{COUPLE2} = P_{IN}$ – 56 dB @ 14 MHz (expected = -57 dB)



– 56 dB

Which Circuit to Use?

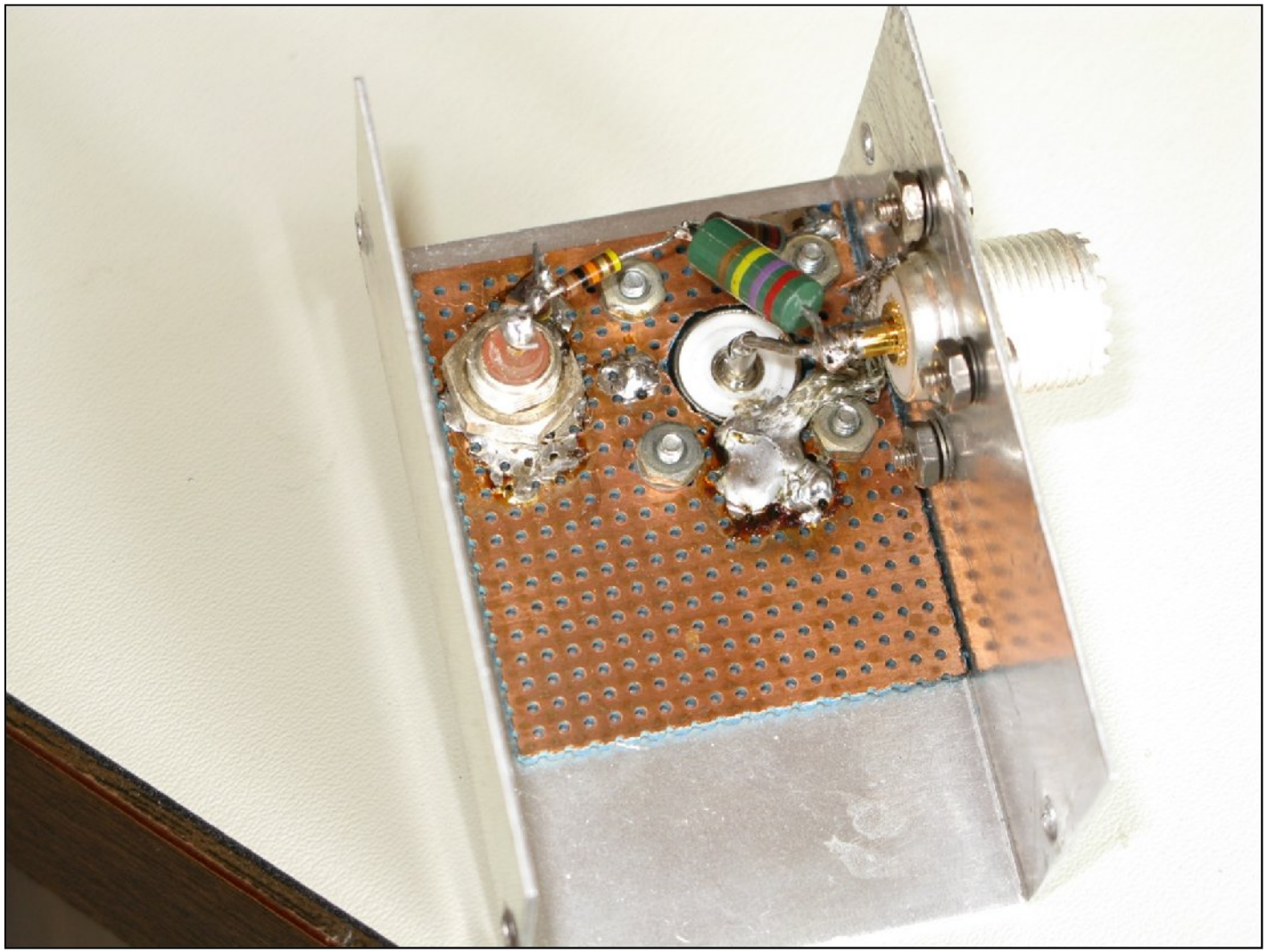
- **Resistive divider network:**
  - Do we really get **-116 dB** [-60+(-56)] coupling factor?



Which Circuit to Use?

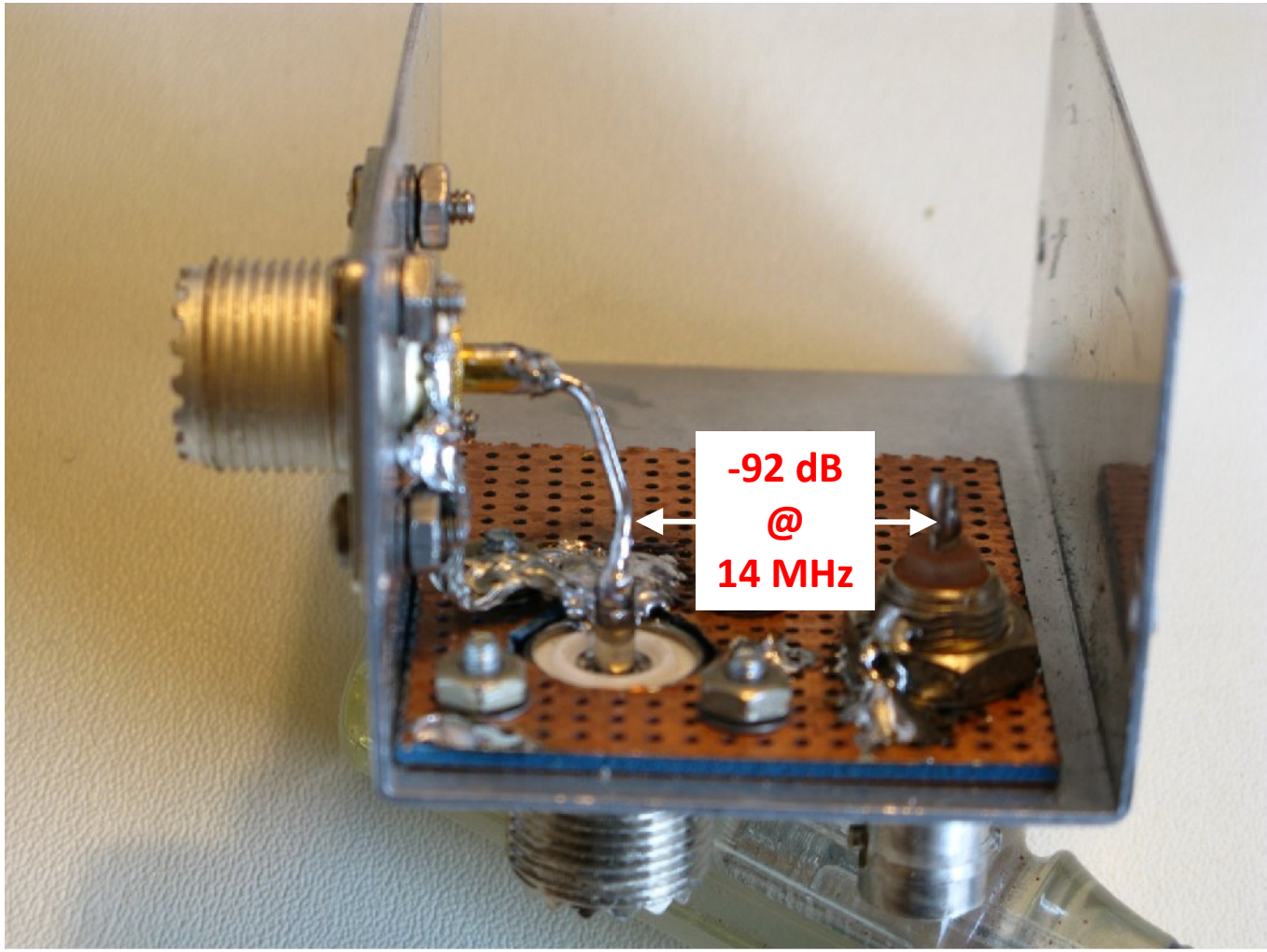
- **Resistive divider network:**
  - Do we really get **-116 dB** [-60+(-56)] coupling factor? **No!**

Only get -92 dB @ 14 MHz!



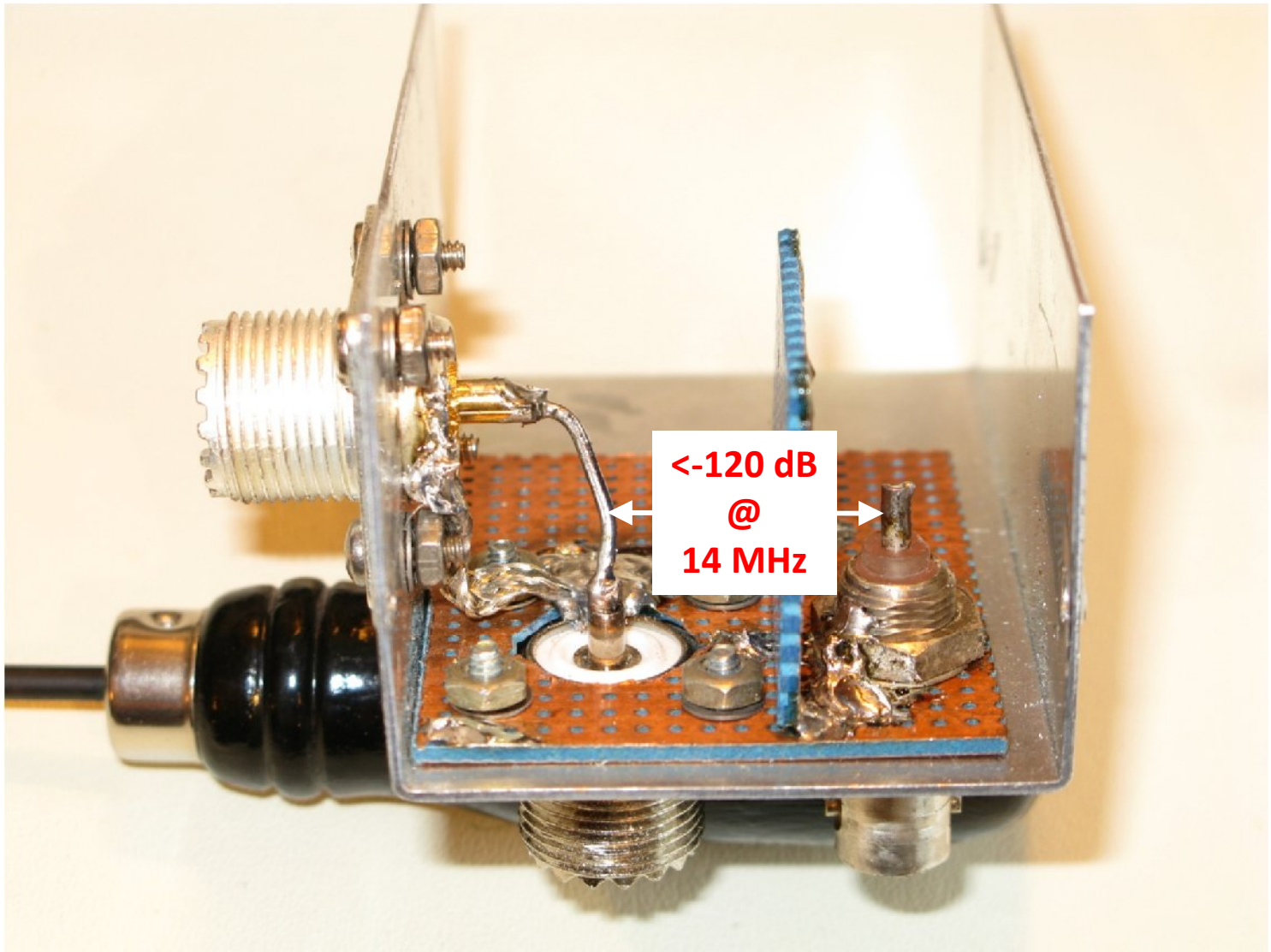
Which Circuit to Use?

- **Isolation @ 14 MHz:**



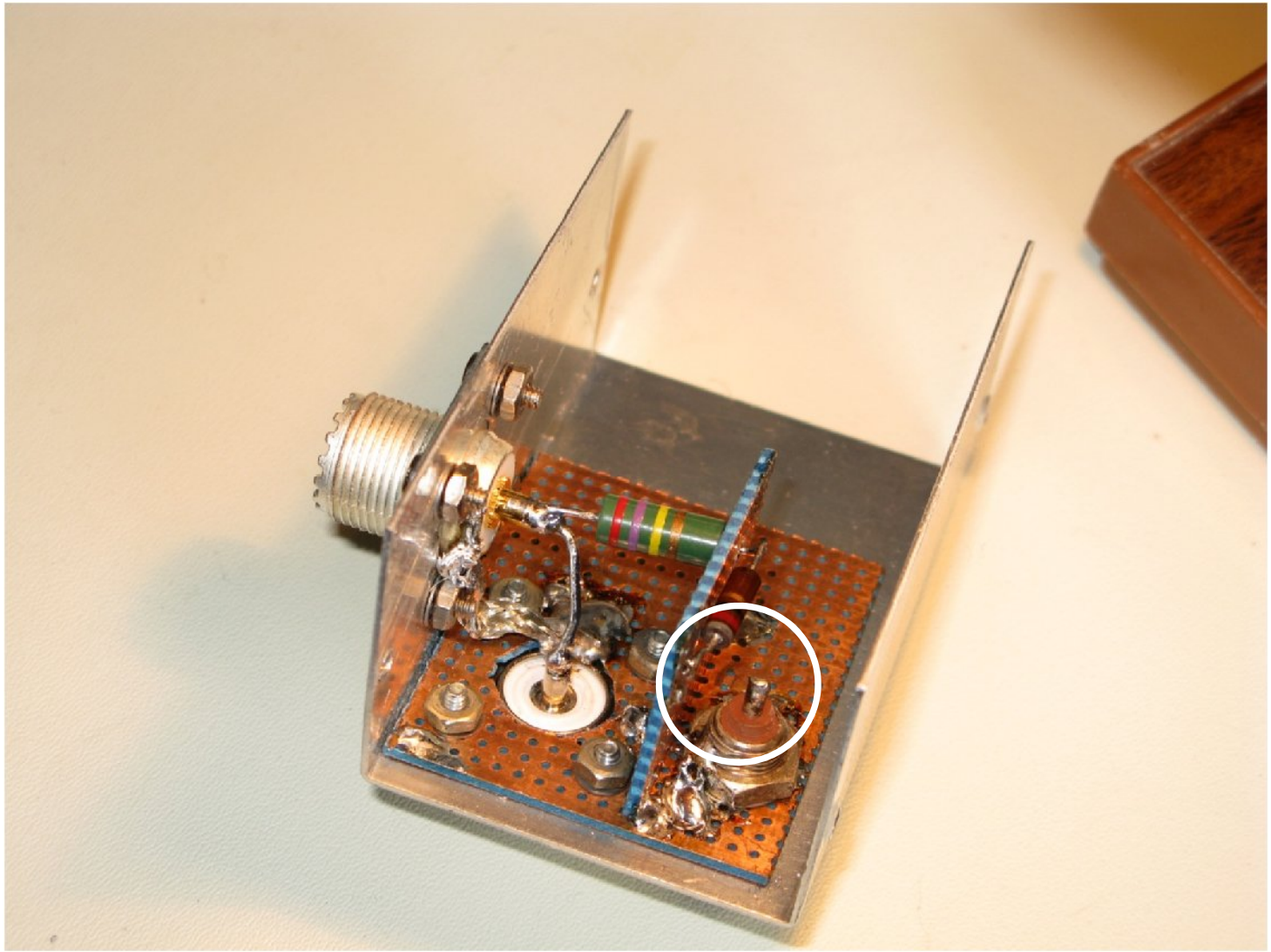
Which Circuit to Use?

- **Isolation @ 14 MHz:**



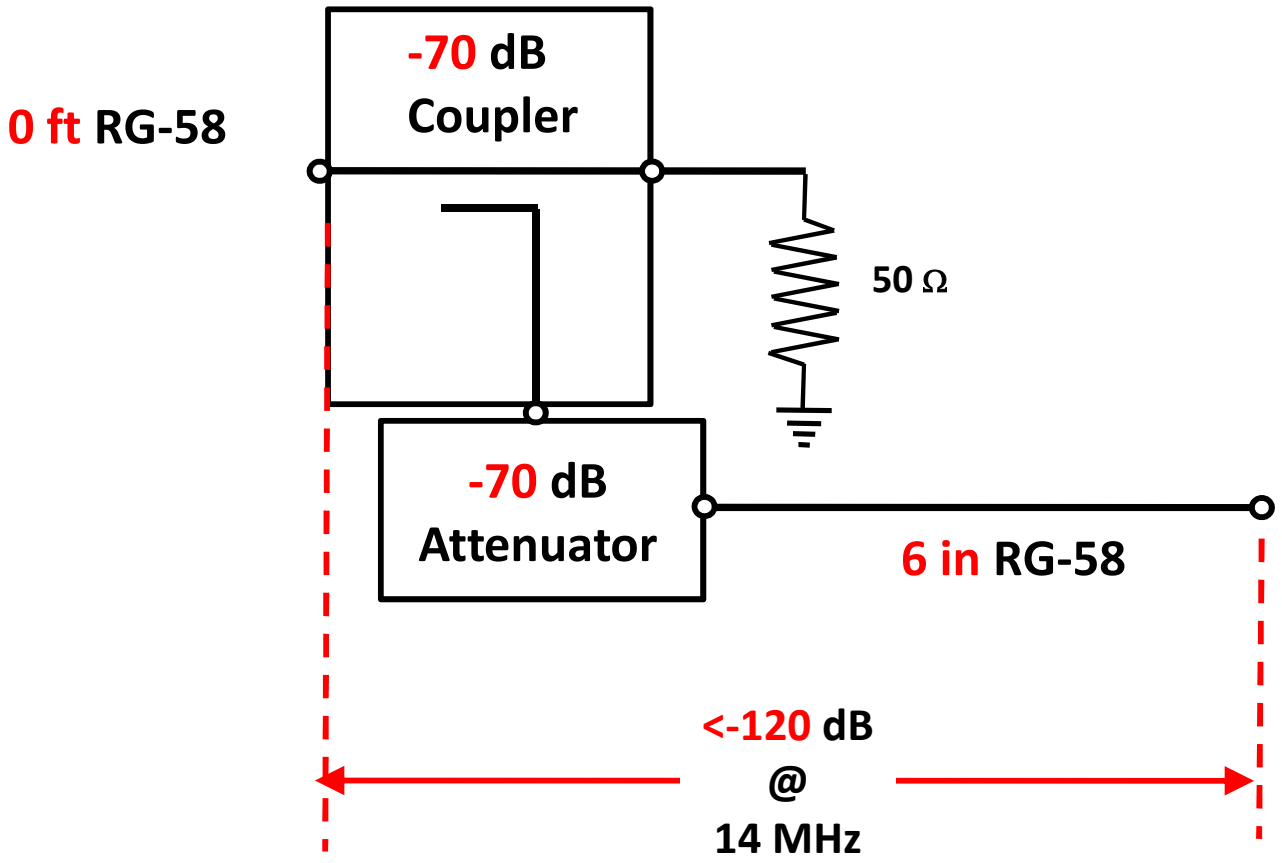
Which Circuit to Use?

- **-110 dB Isolation @ 14 MHz :**



Which Circuit to Use?

- **Isolation @ 14 MHz:**



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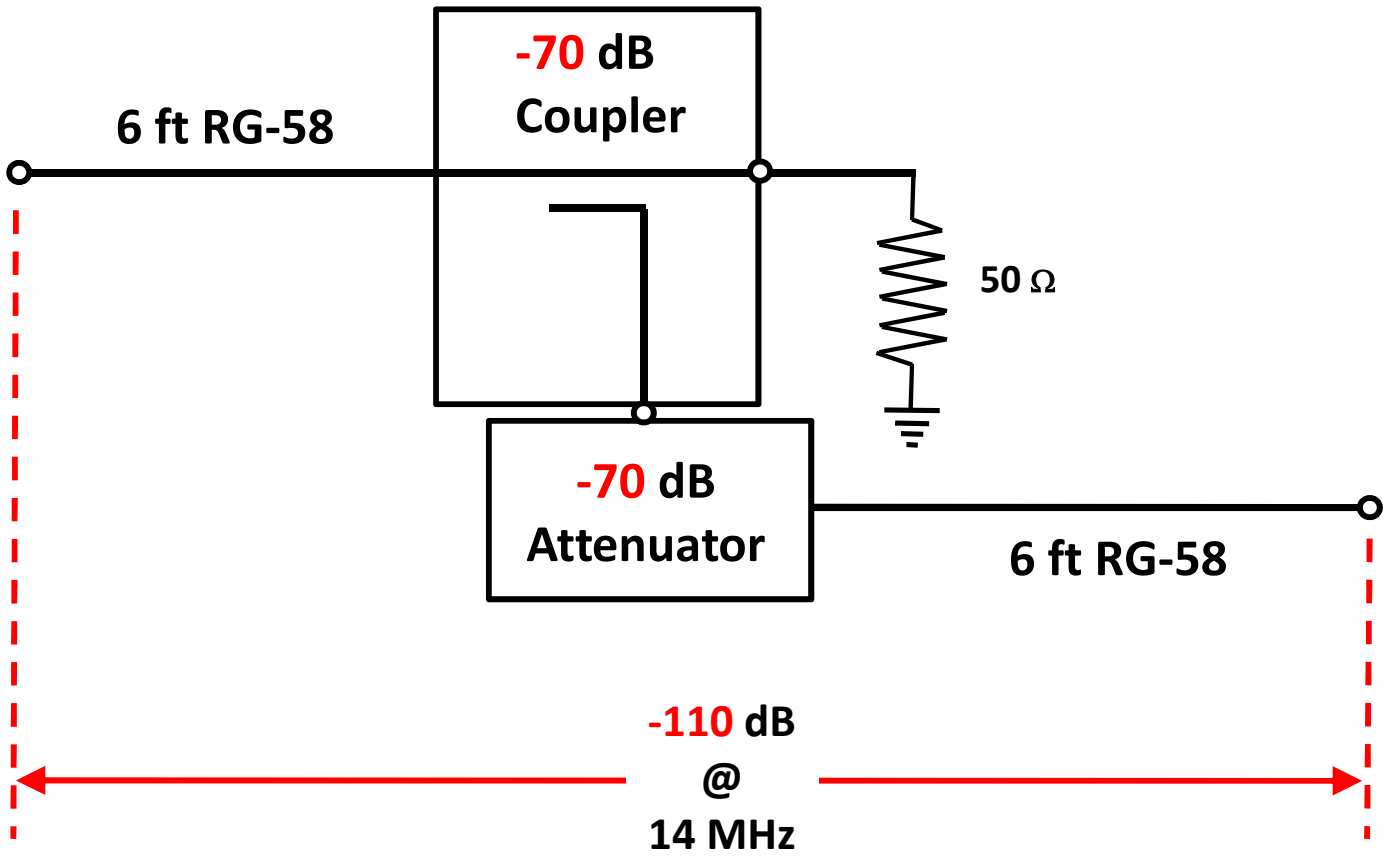
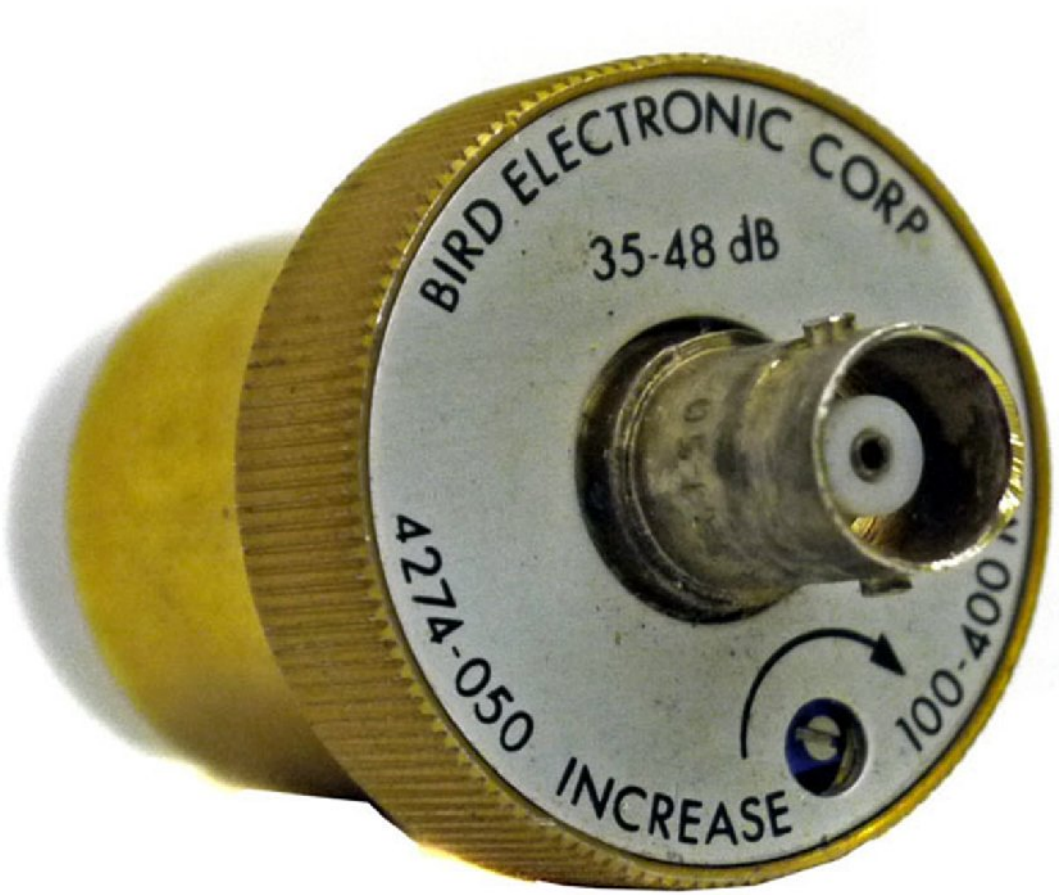


Which Circuit to Use?

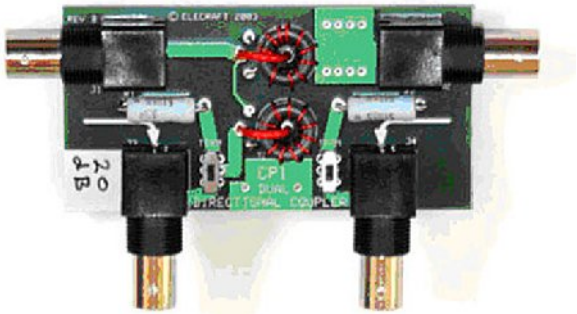
- **Bird RF Samplers (>$100)**
  - **Like all of their slugs, these are also band specific**



Elecraft Has Many Kits

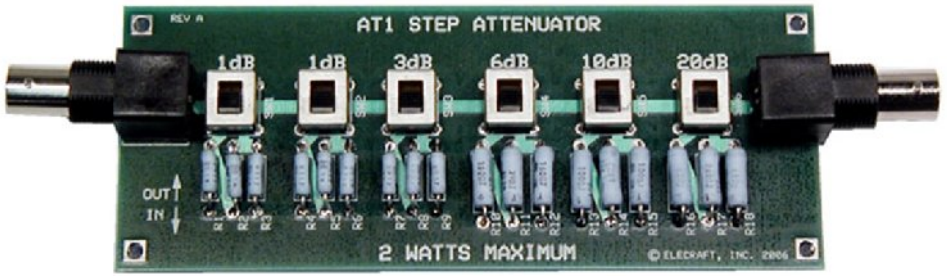
CP1 Directional Coupler

- 1-30 MHz
- Coupling;
  - 20 dB/25 watt
  - 30 dB/250 watt
- **$40** (kit)



AT1 41 dB HF/VHF Switched Attenuator

- DC-220 MHz
- 0-41 dB
- **$60** (kit)

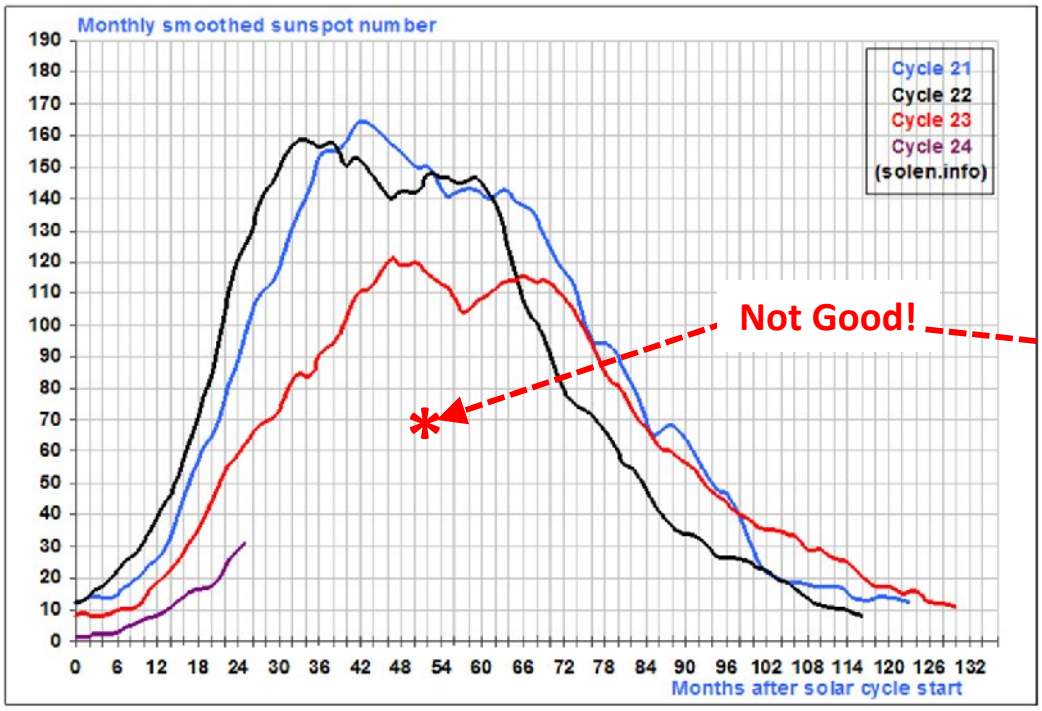


2T-gen 2-Tone Test Oscillator

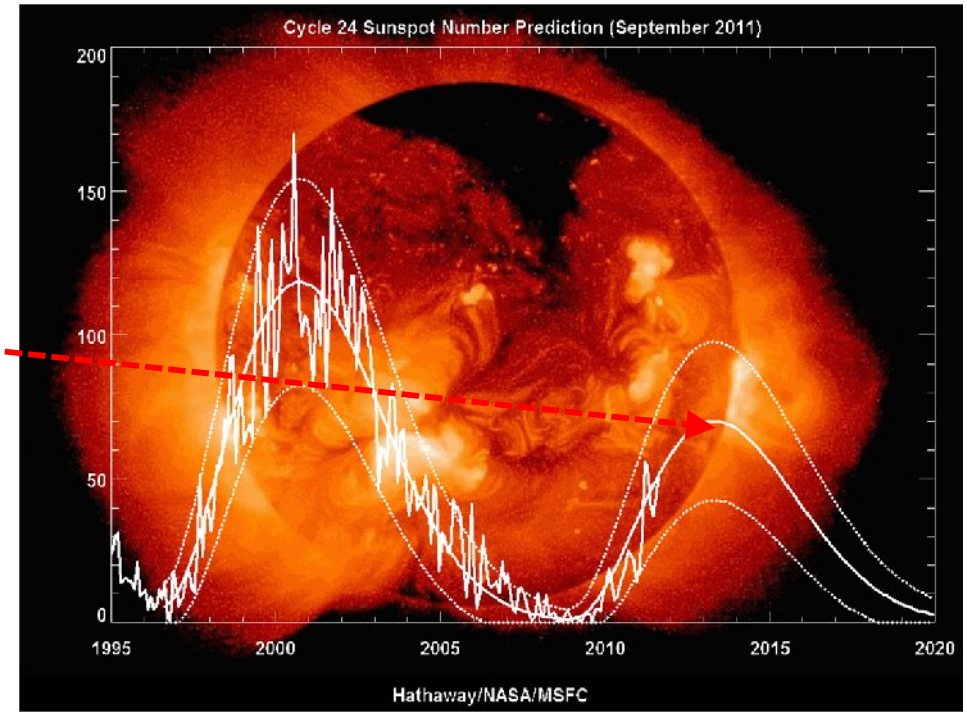
- **$70** (kit)

Propagation Update:

- Up & down summer
- Increasing number of significant flares & CMEs
- NASA now predicts the SSN peak to be **69 in May 2013**



Not Good!



Info of General Interest

- ARRL Convention reports?

Info of General Interest

- Genesis G59 SDR Transceiver

Upcoming Events

- Upcoming Club Meetings:
  - **October 1**
  - **November 5 (TechFest)**
    - **Location: Fire station #1**
  - **December 3 (Holiday lunch)**
- Swapfests:
  - BARCfest (Sept 25 in Longmont)
  - ?
- Edge of Space Sciences (EOSS) Baloon Launches:
  - 05-Nov-2011 (Dual launch?)
- Other events to list?

Presentation(s)

http://www.naøtc.org/

Measuring RF Parameters of Networks